



WATER RESOURCES RESEARCH GRANT PROPOSAL

Title: Watershed Transport and Transformations of Atmospherically Derived Mercury: A Whole Ecosystem Amendment Study

Focus Categories: Non Point Pollution, Toxic Substances, Hydrogeochemistry

Keywords: Heavy Metals, Contaminant Transport, Rainfall-Runoff Processes, Soil-Water

Relationships, Wetlands, Isotopes

Duration: September 1, 2000 to August 31, 2003

Federal Funds Requested: \$206,011

Non-Federal (matching) funds pledged: \$206,012

Principal Investigators :

James P. Hurley University of Wisconsin – Water Resources Institute

David P. Krabbenhoft U.S. Geological Survey, Middleton, WI

Kristofer R. Rolhus University of Wisconsin – Water Chemistry Program

Congressional District: 2nd District, Wisconsin

Abstract

Mercury (Hg) bioaccumulation in higher trophic levels of the aquatic food chain has led to widespread issuance of consumption advisories in the U.S. and Canada. In areas remote from direct point source dischargers, Hg enters most ecosystems through atmospheric deposition. Watersheds, in turn, can exert a strong effect on the biogeochemical cycling of Hg by allowing for conditions that enhance transport and partitioning of Hg to aquatic systems. Advances in low-level Hg analyses have allowed investigators to accurately measure both total and methyl Hg at ambient environmental levels, and study Hg cycling processing in watersheds. However, it has been difficult to conduct studies that directly assess the effects of variations in Hg *loading* on bioaccumulation in predatory fish, as we were previously unable to distinguish recent atmospheric deposition and transport from historical storage.

The recent development of Inductively Coupled Plasma-Mass Spectrometry (ICP-MS) techniques has allowed for direct analysis of stable Hg isotopes at ambient levels. We have proposed a large multi-investigator study to add Hg stable isotopes to an entire watershed (individual isotopes each to a lake, upland and wetland portion of the watershed) through the “Mercury Experiment To Assess Atmospheric Loading in Canada and the United States (METAALICUS)” project. The University of Wisconsin-Madison and U.S. Geological Survey (Middleton, WI) portion of the study proposes to investigate watershed partitioning, transformations and transport processes that influence bioavailability to a northern temperate lake. The specific objectives of our phase of the METAALICUS project are to: 1) Determine the fraction of watershed Hg yield that is due to “new deposition” versus that derived from the - 3 - historic pool of Hg in the soils and vegetation; 2) Provide direct observations on the extent of mobility of new Hg in upland soils and wetland peat; 3) Isolate and characterize transport vectors (dissolved organic carbon, colloids, particulates) leading to export from different watershed components; 4) Assess the effects of partitioning and pathway in influencing bioavailability of Hg derived from uplands and wetlands to the lacustrine food web; and 5) Elucidate the contribution of new versus historic Hg to the formation and optimal

locations for methylation of Hg and relative mobility for transport to the lake. Our approach in the first year of study is to perform test plot experiments to help determine the proper techniques for full-scale addition of isotopes to the watershed. During years two and three of the study, we will apply methods proven successful from pilot experiments to the full-scale application phase for watershed Hg-cycling studies. We will employ specific hydrologic and geochemical techniques to address particulate, colloidal and dissolved transport of total and methyl Hg.